

## CLAIMS

We claim:

1. A method in a computing device for retrospectively analyzing experiences of a human user of a general-purpose computing device, comprising:
  2. of a multiplicity of data items relating to experiences of the human user,
  3. reiteratively obtaining and storing values of a selected plurality of the multiplicity, each stored value being stored with an indication of its data item and an indication of its effective time;
  4. after storing the values, receiving a specification for analyzing values among the stored values, the specification specifying one or more data items, a range of effective times, and an analysis technique;
  5. retrieving stored values for the specified data items within the specified range of effective times; and
  6. applying the specified analysis technique to the retrieved values to produce an analysis of experiences of the human user.
2. The method of claim 1 wherein the general-purpose computing device in which the method is performed is a general-purpose mobile computer system.
3. The method of claim 1 wherein the general-purpose computing device in which the method is performed is a general-purpose wearable computer system.
4. The method of claim 1 wherein the general-purpose computing device in which the method is performed is a body-supported general-purpose computer system.
5. The method of claim 1, further comprising storing in conjunction with the stored data item values the following additional units of information relating to the stored data item values: data item name, uncertainty, effective time, units, source, and storage time.

6. The method of claim 1 wherein the stored values are stored in tab-  
1 delimited ascii rows.

1 7. The method of claim 1 wherein the stored values are stored in a  
2 relational database.

1 8. The method of claim 1 wherein the stored values are stored in a sparse  
2 matrix.

*SUB C1*

9. A method in a computing device for specifying context attributes for  
1 logging, comprising:  
2 displaying a list of context attributes available in the computing device;  
3 receiving user input identifying a subset of the displayed available context  
4 attributes for logging; and  
5 selecting the identified context attributes for logging.

10. The method of claim 9 wherein a proper subset of the displayed  
1 available context attributes are selected.

11. The method of claim 9 wherein a single displayed available context  
1 attributes is selected.

12. The method of claim 9, further comprising periodically storing values of  
1 the selected context attributes.

13. The method of claim 9, further comprising receiving user input  
2 identifying, for each of the selected context attributes, a log in which the selected context  
3 attribute is to be logged.

*Sub A<sup>1</sup>*

14. The method of claim 13, further comprising, for each the selected context attributes, periodically storing values of the selected context attribute in the log identified for the selected context attribute.

*Sub C37*

15. The method of claim 9, further comprising associating with each selected context attribute a frequency at which the selected context attribute is to be logged.

16. The method of claim 15, further comprising, for a distinguished one of the selected context attributes, receiving user input specifying the frequency at which the distinguished context attribute is to be logged that is associated with the distinguished context attribute.

17. The method of claim 9 wherein a distinguished one of the selected context attributes is available from each of a plurality of sources, the method further comprising selecting one of the sources from which to obtain the distinguished context attribute that is to be logged.

18. The method of claim 17, further comprising receiving user input specifying the source from which to obtain the distinguished context attribute that is to be logged.

19. The method of claim 9 wherein values for context attributes may be cached, and wherein each cached context attribute value has an age, the method further comprising determining for a distinguished one of the selected context attributes a maximum age at which cached values of the distinguished context attribute may be logged.

20. The method of claim 19 wherein the determined maximum age is based upon user input.

21. The method of claim 9, further comprising determining for a  
1 distinguished one of the selected context attributes a processing technique to which the  
2 distinguished context attribute is to be subjected before logging.

22. The method of claim 21 wherein the determined processing technique is  
1 based upon user input.

23. The method of claim 9, further comprising determining for a  
1 distinguished one of the selected context attributes a processing technique to which the  
2 logged distinguished context attribute is to be subjected at a time subsequent to logging.

24. The method of claim 23 wherein the determined processing technique is  
1 based upon user input.

25. The method of claim 9, further comprising determining for a  
1 distinguished one of the selected context attributes an importance level reflecting the  
2 importance of retaining the logged distinguished context attribute.

26. The method of claim 25 wherein the determined importance level is  
1 based upon user input.

27. The method of claim 9, further comprising identifying for a  
1 distinguished one of the selected context attributes an alternative source from which the  
2 distinguished context attribute may become available at a future time.

28. The method of claim 27 wherein the identified alternative source is  
1 based upon user input.

29. A computer-readable medium whose contents cause a computing device  
1 to specify context data items for logging by:  
2 displaying a list of available data items;

4 receiving user input identifying a subset of the displayed available data items  
5 for logging; and  
6 selecting the identified data items for logging.

30. One or more computer memories that collectively contain a context  
1 attribute logging configuration data structure specifying how context attributes are to be  
2 logged, comprising entries each corresponding to a context attribute and indicating that the  
3 context attribute should be logged,

4 such that the data structure may be used to identify context attributes for  
5 logging.

31. The memories of claim 30 wherein each entry of the data structure is a  
1 record.

32. The memories of claim 30 wherein each entry of the data structure  
1 further specifies a frequency at which the context attribute to which the entry corresponds is  
2 to be logged.

33. The memories of claim 30 wherein one or more selected entries of the  
1 data structure which corresponds to a context attribute that may be available from more than  
2 one source further specifies a particular source from which to obtain the context attribute to  
3 which it corresponds.

34. The memories of claim 30 wherein values for context attributes may be  
1 cached, and wherein each cached context attribute value has an age, and wherein each of one  
2 or more selected entries of the data structure specifies a maximum age at which cached  
3 values of the context attribute to which the entry corresponds may be logged.

35. The memories of claim 30 wherein each of one or more selected entries  
1 of the data structure specifies a processing technique to which the corresponding context  
2 attribute is to be subjected before logging.

36. The memories of claim 30 wherein each of one or more selected entries  
1 of the data structure specifies a processing technique to which the corresponding context  
2 attribute is to be subjected at a time subsequent to logging.

37. The memories of claim 30 wherein each of one or more selected entries  
1 of the data structure specifies an importance level reflecting the importance of retaining  
2 information produced by logging the corresponding context attribute.

38. The memories of claim 30 wherein each of one or more selected entries  
1 of the data structure specifies an alternative source from which the corresponding context  
2 attribute may become available at a future time.

39. A method in a computing device for specifying context attributes for  
1 logging, comprising:

2 displaying a list of groups of context attributes available in the computing  
3 device;

4 receiving user input identifying a subset of the displayed groups of available  
5 context attributes for logging; and

6 selecting the context attributes of the identified groups for logging.

7  
1 40. The method of claim 39 wherein one of the displayed groups of  
2 available context attributes contains context attributes relating to travel.

8  
1 41. A method in a computing device for logging context attributes,  
comprising:

2 for each of a set of selected context attributes, determining a target frequency  
3 with which values of the selected context attribute are to be logged;

4 for each of the set of selected context attributes, obtaining values of the  
5 selected context attribute at a frequency approximating the target frequency determined for  
6 the selected context attribute; and

8                   for each obtained context attribute value, writing the obtained value to a  
9 storage device in a manner that identifies its context attribute.

1                  42. The method of claim 41 wherein the obtained values are written to a  
2 storage device in the computing device.

1                  43. The method of claim 41 wherein the obtained values are written to a  
2 storage device external to the computing device

1                  44. The method of claim 43 wherein values obtained in a plurality of  
2 computing devices are written to the storage device external to the computing device.

1                  45. The method of claim 41 wherein the method utilizes a characterization  
2 module, and wherein, for each of the selected context attributes, a context server module is  
3 registered with the characterization module to provide the selected context attribute, and  
4 wherein the obtaining a value of a selected context attribute involves requesting, by the  
5 characterization module, a value of the selected context attribute from the context server  
module registered to provide the selected context attribute.

1                  46. The method of claim 41, further comprising, for values of a  
2 distinguished one of the selected context attributes, applying a selected summarization  
3 technique to adapt the values of the distinguished context attribute before storing them.

1                  47. The method of claim 41, further comprising, for values of a  
2 distinguished one of the selected context attributes, applying a selected abstraction technique  
3 to adapt the values of the distinguished context attribute before storing them.

1                  48. The method of claim 41, further comprising, for values of a  
2 distinguished one of the selected context attributes, applying a selected compression  
3 technique to adapt the values of the distinguished context attribute before storing them.

49. One or more computer memories that collectively contain a context  
1 attribute log data structure, comprising entries each containing information identifying a  
2 context attribute, an effective time, and a value produced for the context attribute having the  
3 effective time,

4 such that the data structure may be used to determine values produced for a  
5 context attribute having an effective time within a range of effective times.

50. The computer memories of claim 49 wherein each entry further  
1 specifies an uncertainty level characterizing the likely level of accuracy in the value of the  
2 entry.

51. The computer memories of claim 49 wherein each entry further  
1 specifies units in which the value of the entry is expressed.

52. The computer memories of claim 49 wherein each entry further  
1 identifies the time at which the entry was stored.

53. The computer memories of claim 49 wherein each entry further  
1 identifies the source of the value of the entry.

SUB C4)

54. A method in a computing device for maintaining a log of context  
1 attributes, comprising:

2 accessing the log of context attributes, which contains values for each of a  
3 plurality of context attributes; and

4 applying to values of a selected one of the plurality of context attributes  
5 contained by the log a maintenance technique that has the effect of reducing the amount of  
6 storage space occupied by the log.

55. The method of claim 54 wherein the applied maintenance technique is a  
1 compression technique.

56. The method of claim 54 wherein the applied maintenance technique is a summarization technique.

57. The method of claim 54 wherein the applied maintenance technique is a thinning technique that discards a portion of the values of the selected context attribute while retaining others.

58. The method of claim 54 wherein the applied maintenance technique discards all values of the selected context attribute.

59. The method of claim 54 wherein the applied maintenance technique is an information abstraction technique.

60. The method of claim 54 wherein the applied maintenance technique is an archiving technique that removes values of the selected context attribute from the log and stores them outside the log.

61. The method of claim 54 wherein an importance level is specified for each of the context attributes whose values are contained by the log, the method further comprising:

comparing the importance levels specified for the context attributes; and

selecting a context attribute to which to apply a maintenance technique based upon the results of the comparison.

62. The method of claim 54, further comprising the steps of:

determining that values for a distinguished one of the context attributes whose values are contained by the log are available from an independent source; and  
based upon the determination, selecting the distinguished context attribute to which to apply a maintenance technique.

63. A method in a computing device for retroactively analyzing a log of

2 context attribute values, each context attribute value contained by the log being stored with  
3 an indication of its data item and an indexing value, the method comprising:  
4 receiving a specification for analyzing values among the stored values, the  
5 specification specifying one or more context attributes, a range of indexing values, and an  
6 analysis technique;  
7 retrieving stored values for the specified context attributes within the specified  
8 range of indexing values; and  
9 applying the specified analysis technique to the retrieved values to produce an  
10 analysis of the context attributes.

1 SUB C6) 64. The method of claim 63 wherein the indexing values are effective times  
2 associated with the data items.

3  
4 65. The method of claim 63 wherein a first portion of the retrieved values  
5 were produced by a first attribute value-producing computing device and a second portion of  
6 the retrieved values that is distinct from the first portion of the retrieved values were  
7 produced by a second attribute value-producing computing device.

8  
9 66. The method of claim 63 wherein the specified analysis technique is a  
10 summarization technique.

11  
12 67. The method of claim 63 wherein the specification specifies two or more  
1 context attributes and specifies an analysis technique that involves combining values of the  
2 specified context attributes.

13  
14 68. The method of claim 63 wherein application of the specified analysis  
1 technique produces a new context attribute value.

15  
16 69. The method of claim 63 wherein a rule designed for analyzing context  
1 attribute values in real-time to produce a result is available in the computing device, and  
2 wherein the specified analysis technique includes determining a result that would have been

4 produced if the rule had been applied to analyze the specified context attribute values at the  
5 time they were generated.

1 70. The method of claim 69 wherein the available rule is obtained from a  
2 second, distinct computing device in which the available rule has already been adopted.

1 71. The method of claim 69, further comprising adopting the rule for future  
2 real-time application if it is determined that a successful result would have been produced if  
3 the rule had been applied to analyze the specified context attribute values at the time they  
were generated.

1 72. The method of claim 63 wherein the specified analysis technique  
identifies a recurring pattern in the retrieved context attribute values.

1 73. The method of claim 72, further comprising:

2 determining that the most recent pattern recurrence is identified in context  
attribute values having effective times only shortly preceding the present time;

3 determining that the retrieved context values include context values reflecting  
4 an action taken by a user subsequent and proximal to at least one earlier occurrence of the  
5 pattern; and

6 based upon both determinations, making preparations in anticipation of  
7 repetition of the action by the user.

74. The method of claim 72, further comprising:

1 determining that the most recent pattern recurrence is identified in context  
2 attribute values having effective times only shortly preceding the present time;

3 determining that the retrieved context values include context values reflecting  
4 commands issued by a user subsequent and proximal to at least one earlier occurrence of the  
5 pattern; and

6 based upon both determinations, presenting to the user an offer to repeat the  
7 issued commands.

~~75.~~ The method of claim 63 wherein the specified analysis technique  
1 identifies in the retrieved context attribute values a pattern specified outside the log.

*Sub A<sup>3</sup>* ~~76.~~ The method of claim 63 wherein the pattern specified outside the log  
1 characterizes a particular diagnosis of user condition, and wherein the specified analysis  
2 technique further attributes the diagnosis to the user condition reflected in the retrieved  
3 context attribute values.

*Sub C<sup>8</sup>* ~~77.~~ The method of claim 76 wherein the diagnosis characterized by the  
1 pattern specified outside the log is a medical diagnosis.

*Sub A<sup>4</sup>* ~~78.~~ A computing device for retroactively analyzing a log of context attribute  
1 values, each context attribute value contained by the log being stored with an indication of its  
2 data item and an indication of its effective time, comprising:  
3       a specification receiver that receives a specification for analyzing values among  
4       the stored values, the specification specifying one or more context attributes, a range of  
5       effective times, and an analysis technique;  
6       a value retrieval subsystem that retrieves stored values for the specified context  
7       attributes within the specified range of effective times; and  
8       an analysis subsystem that applies the specified analysis technique to the  
9       retrieved values to produce an analysis of the context attributes.

*Sub C<sup>10</sup>* ~~79.~~ The computing device of claim 78 wherein the computing device is a  
1 mobile computer system.

~~80. The computing device of claim 78 wherein the computing device is a  
1 wearable computer system.~~

~~81. A method in a computing device for specifying the simulation of  
1 selected earlier-occurring conditions, comprising:  
2       displaying a list of context attributes available in the computing device;~~

4 receiving user input identifying a subset of the displayed available context  
5 attributes to include in a simulation; and  
6 selecting the identified context attributes for inclusion in the simulation,  
7 such that, when the simulation is initiated, earlier-recorded values of the  
8 selected context attributes will be substituted for current values of the selected context  
9 attributes.

*Sub A6*

1 82. The method of claim 81 wherein a sequence of values of each of the  
2 selected context attributes is to be recorded, the method further comprising receiving user  
3 input specifying a speed at which substitute the values of each sequence for the current  
4 values of the selected context attributes relative to a speed at which the sequences of values  
are to be recorded.

1 83. A method in a computing device for conducting a simulation of selected  
2 earlier-occurring conditions for the benefit of a data consumer, comprising:  
3 of a multiplicity of data items whose values are available in real-time in the  
4 computing device, selecting a subset of the available data items to include in the simulation;  
5 during a simulation period, for each of the selected data items, making  
6 available a sequence of earlier-recorded values for the selected data item in place of the real-  
time values of the selected data item,  
7 such that, during the simulation period, earlier-recorded values are available for  
8 the selected data items, while real-time values are available for data items other than the  
9 selected date items.

1 84. The method of claim 83 wherein data item values are provided by a  
2 characterization module in response to requests from data item consumers, the method  
3 further comprising, in the characterization module:  
4 receiving a request for a data item from a requesting data item consumer;  
5 determining whether the requested data item is among the selected data items;  
6 if the requested data item is among the selected data items, providing the  
requesting data item consumer with an earlier-recorded value of the data item; and

8                   if the requested data item is not among the selected data items, providing the  
9                   requesting data item consumer with a real-time value of the data item.

85.               The method of claim 84, further comprising, if the requested data item is  
1                  not among the selected data items, obtaining the provided real-time value of the data item  
2                  from a source associated with the data item.

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